energy circulation and physiological activation and associate with water molecules strongly to activate water. Also, far-infrared rays have multiple functions such as maintaining the freshness of all food stuffs, making foods tasty, deodorization, promoting growth of plants and animals, uniform heating or drying for a reduced time, and rising the temperature internal or external of an object.

The related art techniques concerning far-infrared materials having such efficacies are disclosed, for example, in Korean Patent Publication Nos. 94-2031, 94-5085 and 96-7375 and relate to the materials that have far-infrared functions solely free from non-thermal far-infrared radiation and give no effect involving vital strength enhancement, absorption or neutralization of harmful electromagnetic wave, control of water vein, or the like. As for neutralizing agent of harmful electromagnetic wave, the technique is described in Korean Patent Laid-open No. 97-21141, which relates to electromagnetic wave shielding only and does not mention other effects such as non-thermal far-infrared radiation, vital strength enhancement, air purification, water vein control, improvement of water and soil qualities, and so on.

Disclosure of Invention

An objective of the present invention is to provide a novel composition of a far-infrared radiation material having multiple functions such as emission of non-thermal far-infrared rays, vital strength enhancement, air purification, absorption or neutralization of harmful electromagnetic waves, control of water vein, improvement of water and soil qualities, and the like.

To accomplish the objective of the present invention, provided is a composition of a

multipurpose far-infrared radiation material including: 0.2-38 parts by weight of at least one non-metal compound selected from the group consisting of SiO_2 and P_2O_5; 0.01-70 parts by weight of at least one metal compound selected from the group consisting of TiO_2, Al_2O_3, Fe_2O_3, FeO, MnO, MgO, CaO. Na_2O, K_2O, Cr_2O_3, NiO, BaO and SrO; 0.01-2 parts by weight of at least one rare earth element selected from the group consisting of Nd, Y, Ce, Sm, La and Yb; and 0.02-18 parts by weight of at least one element selected from the group consisting of C, Cr, Ni, Ba, Sr, Co, Cu, Li, Nb, Zr, Zn and Ge.

In addition, the present invention provides the composition of a multipurpose far-infrared radiation material that may be used as a mixing or coating form in combination with all sorts of metallic and nonmetallic materials such as loess, Mcbansuk, jade, feldspar, amphibole, biotite, beryl, Yangkisuk, sericite, talc, green jadeite, serpentine, noble serpentine, tourmaline, rare earth stone, actinolite, augite, agalmatolite, zeolite, charcoal, clay, silica, ilmenite, chlorite, garnet, zircon, china stone (kaoline), olivine, malachite, quartz, jasper, pearl, sapphire, ruby, turquoise, chalcedony, tiger's eye, emerald, agate, cat's eye, water stone, chalcopyrite, copper, aluminum, tungsten, jet, scaly graphite, sand, heavy sand, granite, marble, cement, water, metals, nonferrous metals, plastics, fibers, asphalt, wood, cotton, unwoven yarn, rubber. pigment, paint, ink, pulp (paper), glass, ceramic wares, tile, artificial precious stone, vinyl, cork, adhesives, silicon and the like.

The most preferable composition ratio is determined within the most effective range that is obtained by measuring the amount and wavelength of far-infrared rays for a long time while varying the composition ratio of the above-mentioned farinaceous far-infrared material, followed by vital strength enhancement test, harmful electromagnetic wave shielding test, and

water vein control test.

The components in the present invention composition of a far-infrared radiation material are mixed as a farinaceous form to constitute the composition. The composition may be used without a firing process or, if necessary, may be fired at high temperature of 100-2500 °C (according to its use purpose) and then pulverized, or molded before use. Thus obtained powder of the far-infrared radiation material is not limited in particle size and, preferably, may be pulverized to about 10-1000 meshes in consideration of its mixture or moldability in various applications that will be described later.

Brief Description of Drawings

Fig. 1 is thermographs before putting on the far-infrared radiation material of Example 1 (spot temperature: 27 °C) and after putting on the far-infrared radiation material of Example 1 for about 10 min (spot temperature: 30.4 °C increased by 0.7 °C. The body temperature rises through economical promotion of the blood circulation.);

Fig. 2 is thermographs of the left hand before holding the far-infrared radiation material of Example 1 with the right hand (spot temperature: 27.7 °C) and after holding the far-infrared radiation material of Example 1 with the right hand for about 10 min (spot temperature: 28.7 °C increased by 1 °C. The temperature on the fingers also rises.);

Fig. 3 is an NMR spectrum of water before passing through the filter; and

Fig. 4 is an NMR spectrum of water after the filter.

Best Mode for Carrying out the Invention

Hereinafter, a composition of a far-infrared radiation material according to the present invention will be described in detail by way of illustrative embodiments with reference to the drawings.

(Example 1)

A far-infrared radiation material is prepared by the composition: 35 parts by weight of SiO_2, 8 parts by weight of TiO_2, 13 parts by weight of Al_2O_3, 8 parts by weight of Fe_2O_3, 8 parts by weight of FeO, 0.2 parts by weight of MnO, 5 parts by weight of MgO, 6 parts by weight of CaO, 2.5 parts by weight of Na_2O, 2.5 parts by weight of K_2O, 0.4 parts by weight of Cr_2O_3, 0.5 parts by weight of P_2O_5, 0.2 parts by weight of NiO, 0.02 parts by weight of BaO, 0.01 parts by weight of SrO, 0.02 parts by weight of Cr, 0.03 parts by weight of Ni, 0.1 parts by weight of Ba, 0.1 parts by weight of Sr, 0.05 parts by weight of Co, 0.5 parts by weight of Cu, 0.08 parts by weight of Li, 0.08 parts by weight of Nb, 0.06 parts by weight of Nd, 0.02 parts by weight of Y, 7 parts by weight of C, 2 parts by weight of Zr, 0.05 parts by weight of Zn, 0.3 parts by weight of Ce, 0.2 parts by weight of Sn, 0.05 parts by weight of La, 0.02 parts by weight of Ge and 0.01 parts by weight of Yb.

(Test 1)

The efficacies of the far-infrared radiation material prepared in Example 1 are determined through various tests as follows:

1. Measurement of far-infrared emissivity

The far-infrared radiation material prepared in Example 1 is compared in regards to the far-infrared emissivity with jade, sericite, Mcbansuk, Keumkang yakdol and loess all of which exhibit high emissivity of far-infrared rays. The results are listed in Table 1.

[Table 1]

Measured Values of Far-infrared Emissivity.

Samples	Measurement Temperature (°C)	Wavelength (μm)	Emissivity (%)	Radiation Energy (x100 $W/m^2.\mu m$)	Radiation Temperature (°C)
Example 1	40	5-20	96	3.87	36.8
Jade	40	5-20	93	3.74	35.3
Sericite	40	5-20	93	3.74	35.7
Mcbansuk	40	5-20	92	3.70	35.7
Keumkang yakdol	40	5-20	92	3.70	35.4
Loess	40	5-20	93	3.74	35.4
The results are obtained against a black body with an FT-IR spectrometer. The radiation temperature is measured at measurement temperature of 19 °C and humidity of 70%.					

As shown in Table 1, the present invention composition of a far-infrared radiation material is more excellent in the far-infrared emissivity relative to natural ores (jade, sericite, Mcbansuk, Keumkang yakdol and loess) which are known to have high far-infrared emissivity.

2. Test of Antimicrobial Function.

A test is performed for the antimicrobial function of the far-infrared radiation material prepared in Example 1 and the results are listed in Table 2.

Test code: KICM-FIR-1002

Used strains: Escherichia coli ATCC 25922, Pseudomonas aeruginosa ATCC 15442

[Table 2]

Results of Antimicrobial Function Test.

Test Items	Sample Division	Initial Concentration (units/ml)	After 6 hrs. (units/ml)	After 24 hrs. (units/ml)	Decrease Rate of Germs (%)
Test with E. coli	Control	267	271	261	2.2
	Example 1	193	28	2	99.3
Test with Pseudomonas aeruginosa	Control	680	660	660	2.9
	Example 1	580	17	4	99.4
- The values for the control are obtained by measurement without using a sample. - The number of germs on the medium is obtained through multiplying by dilution times.					

As shown in the table, the present invention composition of a far-infrared radiation material has an excellent antimicrobial function.

3. Test of Air Purification (Deodorization)

A deodorization test is performed for the far-infrared radiation material prepared in Example 1 and the results are listed in Table 3.

Test code: KICM-FIR-1004

Name of gas tested: ammonia

Measurement of gas concentration: gas detection tube

[Table 3]

Results of Deodorization Test.

Elapsed Time (min)	Concentration of Control (ppm)	Concentration of Sample (ppm)	Deordorability (%)
0	500	500	-
30	490	140	71
60	440	80	82

90	390	30	92
120	390	20	95
The values of the control are obtained through measurement without using a sample.			

The table shows that the present invention composition of a far-infrared radiation material has a good deodorization function.

4. Test of Anti-fungal Function

A test is performed for the anti-fungal function of the far-infrared radiation material prepared in Example 1 and the results are listed in Table 4.

Test code: ASTM G-21

Test fungal isolate (mixed isolates): Aspergillus Niger ATCC 9642

Penicillium Pinophilum ATCC 11797

Chaetomium Globosum ATCC 6205

[Table 4]

Results of Anti-fungal Function Test.

Period of Culture Experiment	After one week	After two weeks	After three weeks	After four weeks
Results	0	0	0	0
Result indicated by zero means no recognition of fungi growth in the sample.				

The table shows that the present invention composition of far-infrared radiation materials has a good anti-fungal function.

5. Test of Blood Circulation Activating Function

A test is performed to study the activation of blood circulation with the far-infrared

radiation material prepared in Example 1.

At the room temperature of 17°C, the far-infrared radiation material prepared in Example 1 is put around the neck of a person to be tested with his face being at 29.7 °C, and the temperature of his face is measured after 10 min (the temperature is 30.4 °C risen from 29.7 °C by 0.7 °C). Photographs of the face taken with a thermography reveal that the blood circulation has been activated all over the face (refer to Fig. 1).

Also, the temperature of the left hand is measured first at the room temperature of 17 °C, and the temperature is measured again for the left hand after holding the far-infrared radiation material prepared in Example 1 with the right hand for about 10 min. The result shows that the left hand is increased in the temperature by 1 °C after 10 min with the right hand holding the far-infrared radiation material without an addition of external heat and that the temperature rises dramatically on the end of fingers (refer to Fig. 2).

6. Test of Vital Strength (Grasping Power) Enhancement

Experiment 1: O-ring test of vital strength enhancement

1) O-ring test is to determine as to whether or not a food stuff suits the physical constitution of a person by compulsorily opening the O-ring formed with his thumb and index fingers of the right hand with the left hand grasping the food stuff. If the food stuff is suitable to the constitution, the fingers do not lose strength but persist in forming O-ring against any external force.

2) It is general under the O-ring test that the grasping power of the index or middle finger is strong enough but that of the ring or little finger is weakened even when the food stuff suits the physical constitution of the person. However, the index, middle, ring and little fingers

of the right hand are all strong in forming the O-ring in the O-ring test performed with the left hand holding the multipurpose material of Example 1.

3) 2 or 3 out of 100 persons have ring fingers strong in nature in the O-ring test normally, but the little fingers are still weak. However, the little finger of the right hand does not lose the strength but becomes strong in forming the O-ring while the left hand grasps the material of Example 1 in the O-ring test.

4) Persons who suffer from neck ruptured disk have grasping power not strengthened with the material of Example 1 on occasion but, after holding the material of Example 1 for about 10-30 min, have grasping power increased even with the ring and little fingers in the O-ring test. This phenomenon appears more rapidly with the material placed under the feet than grasped with the hand.

Experiment 2: Test with grasping power tester.

1) For 20 persons, the grasping power with the thumb and ring fingers is measured before and after using the material of Example 1, and the results are listed in Table 5.

[Table 5]

Grasping power is increased by about 0.5 kg than the material is not used.	5 persons
Grasping power is increased by about 1.0 kg than the material is not used.	10 persons
Grasping power is increased by about 1.5 kg than the material is not used.	3 person
Grasping power is increased by more than 1.7 kg than the material is not used.	2 persons

Experiment 3: Weight (barbell) lifting

1) All 10 persons in their forties can lift a 30 kg barbell with one hand more easily when they holds the material of Example 1.

7. Function of Preventing Declination of Strength Due to Electromagnetic wave (Reducing Electromagnetic Wave Effect).

Experiment 1: Responses after using a cellular phone for 10 min or more.

1) Compared are responses of 15 persons before and after using a cellular phone with the material of Example 1 for more than 10 min.

[Table 6]

Without the Material of Example 1	With the Material of Example 1
13 out of 15 persons have a ringing in the ears and a headache.	12 out of 13 persons who suffered from a ringing in the ears and a headache have neither of them.

2) O-ring tests are performed for 15 persons who form a O-ring with the ring and little fingers while holding a cellular phone with the left hand and all persons have strength weakened. However, the O-ring tests performed in the similar way but with the material of Example 1 show that 14 persons have the strength (grasping power) promoted immediately except for one person who suffers from a neck ruptured disk and has the strength increased after 30 min.

8. Test of Water vein Control Function

A divining rod (L-rod) is deformed into X-shape when finding a water vein (underground water or minerals) but into ll-shape in parallel when a water vein is controlled or interrupted. After finding a spot having underground water or minerals with a divining rod (L rod), a 5 cm x 5 cm x 0.1 mm non-woven fabric coated with the material of Example 1 is placed on the spot. The divining rod over the spot on which the non-fabric is placed becomes parallel into ll-shape, which indicates that the water vein is interrupted or controlled by the

material of Example 1. It is noticeable that a copper or aluminum plate must cover the whole area for the water vein to be interrupted but the material of Example 1 has an effect on the area within the radius of more than 100 times as large as the area of it.

9. Test of Water Quality Improvement

Experiment 1: pH control of water (Increase in the alkalinity)

The material of Example 1 is placed under a cup filled with water whose pH is 6-7. After 3-10 min, pH of the water is increased to pH 8-8.3.

Experiment 2:

A filter is prepared from the material of Example 1 fired at 900-1300 °C and pulverized to 30-40 meshes, and a water having pH 6-7 is passed through the filter. Then, the measured pH of the water is 8-8.3.

Experiment 3:

NMR (Nuclear Magnetic Resonance) spectra of tap water are obtained before and after the same filter as used in Experiment 2.

The spectrum of the tap water appears at 108 Hz before the filter made from the material of Example 1 but is shifted to 51 Hz after the filter. It is reported that the movement of water molecules is active to give a high water quality as the NMR spectrum appears higher. Accordingly, the present invention material is turned out to have an effect to activate water movement and improve water quality.

Fig. 3 shows an NMR spectrum of water before passing through the filter made from the present invention material of Example 1, while Fig. 4 showing an NMR spectrum of water after the filter.

As described above, the composition of a far-infrared radiation material according to the present invention has multiple functions such as emission of non-thermal far-infrared rays, vital strength enhancement, air purification, absorption or neutralization of harmful electromagnetic waves, control of water vein, improvement of water and soil qualities, and the like. Especially, the present invention is applicable to every fields of industry concerning environments, water quality and soil improvement, water purification, health products and hot medical applications, farm-livestock-fisheries products, floriculture, construction, building, food storage and processing, space-air, maglev magnetism, special alloyed steel, motor vehicle, sports, electrical and electronics, and so on.

Industrial Applicability

As follows are the applications of the present invention composition of a far-infrared radiation material:

1. Various materials participating in production of industrial products related to air purification.

2. Materials for improving water quality to obtain clean and potable water and being applicable to the fields of industry related to water purifier. purified water, sauna facilities, purification of waste water, potable water, bath water, water for industrial uses, and the like.

3. Materials having special multipurpose functions that enhance health and life environments in association with far-infrared rays for different industrial products in every fields of industries concerning: construction materials, food life, confectionery, kitchen utensils, medicine and medical applications, health-enhancing foods. food processing, beverage and drinkables, alcoholic drink, accessories, sports, pharmacy, medical treatment and recuperation, farm-livestock-fisheries products and the related processing, heating, electric appliances and electronics, ceramics, paper manufacture, inks, petrochemicals, household articles, textile, apparel, bedding, toiletries, motor vehicles, vessels, flight, space-air, maglev magnetism, special alloyed steel, superconductivity and photocatalyst, heat resistant alloys, special fine ceramic, housing, restaurant business, hotel and lodging, hairdressing, sanitation, nonferrous metals, jewelry and precious metals, rubber, plastics, synthetic resins. timbers, necessities of life such as footwear, headgear, gloves and so on, paints, labels, sticker, fancy. cement, iron ore, office supplies and applications, infant articles, lighting fixtures, pipe, electromagnetic wave and water vein control and shielding systems, energy power system, sanitary ware,

bathtub, data communication appliances, apical new materials, etc..